

WASHINGTON

SCIENCE TRENDS

HIGHLIGHTS

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FEDERAL BUDGET DIGEST

The Federal Government expects to finance over 60 percent of the nation's research and development during the Fiscal Year which ends June 30, 1962. Private industry finances about one-third of the national R&D effort, with smaller amounts provided from funds of foundations, educational institutions and by state and local governments.

Net budget spending for Federal R&D programs is estimated at \$9,443 million in 1962, an increase of \$770 million over 1961 and \$1,701 million over 1960. The 1962 total includes \$609 million for R&D facilities, with the remainder for conduct of R&D.

The totals do not include routine testing, experimental production, information activities or training programs. Slightly less than 70 percent of the funds for research and development will be spent under contract with private industry; about 10 percent through grants and contracts with universities and other non-profit institutions; and the remainder by Government scientists in Federal laboratories.

How is the money allocated between Government Agencies and Programs?

Department of the Defense continues to account for the largest share. About four-fifths of Government-sponsored R&D is directed toward national security needs; a total estimated at \$7,426 million. Defense Department programs alone account for 66 percent of all Federal R&D expenditures; Atomic Energy Programs for 12 percent.

R&D not connected with "major national security" will be up slightly this year at slightly more than \$2 billion, or 21 percent of total Federal R&D expenditures. The National Aeronautics and Space Administration (NASA) expects to spend some \$965 million or almost half this total, with the remainder going to medical research programs and R&D of a number of other civilian agencies.

Basic Research expenditures are estimated at more than \$1 billion in 1962, as compared with about \$800 million in 1961. Over half of this increase is in NASA programs, whose expenditures for basic research are estimated to increase from \$255 million in 1961 to \$375 million in 1962.

The Kennedy Administration and the Congress are, of course, entitled to make any changes in these totals, with the expectation that revisions will be upward.

A Digest of major new plans, policies and programs follows:

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* SPECIAL FIELDS OF R&D EMPHASIS

A number of Agencies are receiving additional funds this year for special fields of R&D Emphasis including seismology, materials research, oceanography, atmospheric sciences, and high energy physics. Detailed breakdowns are now available on the latter three fields:

✓ Oceanography -- A number of Government Agencies will be carrying out expanded programs in this field with a total expenditure estimated at \$81.6 million compared with \$61.7 million in 1961 and \$49.8 million in 1960. The 1962 effort will emphasize a "substantial program" of ship construction to provide new and replacement vessels for research and surveys, an emphasis on the development of new instrumentation, and the construction and support of shore facilities such as a new laboratory at La Jolla, California for research and training of oceanographers. The new National Oceanographic Data Center in Washington will undertake its first full year of operation, and funds are provided for research expeditions in the Indian Ocean and the Antarctic.

✓ Atmospheric Sciences -- Expenditures will grow to more than \$110 million in 1962. However, about 40 percent of this will be in engineering and hardware costs of NASA programs in this field. For actual conduct of basic and applied scientific research about \$40 million will be provided in 1962 -- a \$5 million increase, primarily to exploit new research opportunities created by data from the International Geophysical Year (IGY) and from satellites, and to accelerate atmospheric data acquisition using satellite and rocket probes.

✓ High Energy Physics -- Expenditures for research and construction are estimated at \$90 million in 1962, including \$80 million for AEC programs. In 1961, spending was \$86 million, of which the AEC Share is \$78 million. During 1962 high energy accelerators at Cambridge, Mass. and Princeton, N. J. will begin operation, with a high intensity accelerator under construction at Argonne National Laboratory, Chicago, Ill. Legislation is again proposed to authorize construction at Stanford University of a high energy linear electron accelerator.

* NATIONAL SCIENCE FOUNDATION PROGRAMS

The National Science Foundation, although dealing primarily with non-classified basic research, provides only bare outlines of its programs for 1962. The new spending authority increases to \$210 million, compared with \$175.8 million in 1961 and \$154.8 million in 1960. In addition to training expenditures and fellowships reported elsewhere in this issue, the NSF will sponsor programs for research in oceanography, in the geology and geophysics of the deeper layers of the earth and for weather modification. Special facilities to be supported include radio and optical astronomy observatories, a solar research telescope, university nuclear research facilities, university computers, and oceanographic ships and shore facilities. The Foundation is expanding its program matching grants for assistance in the modernization of graduate level laboratories at colleges and universities. Support will also be provided for specialized biological laboratories, for the establishment of a national center for atmospheric research, and for the construction of a geophysical institute in Hawaii. Foreign currencies will be used to continue present scientific translation programs in Israel, Poland and Yugoslavia, and to carry out studies and initiate pilot programs in India and Egypt.

* TENNESSEE VALLEY AUTHORITY

The 1962 budget includes fundamental and applied research and process engineering in the laboratory and through pilot plant operation. "Significant" projects here will include research on the compound oxamide and on nonexplodable ammonium nitrate; studies and development work on high temperature techniques for the production of nitrogen compounds and work on ammonium polyphosphate and granular potassium metaphosphate.

* ATOMIC ENERGY COMMISSION PROGRAMS

Once again this year, there is little change in the AEC budget. Expenditures of \$2,680 million in 1962 compare with an estimated \$2,660 in 1961. Reductions, notably in the procurement of uranium concentrates and a cutback in the Aircraft Nuclear Propulsion program, are offset by increases in several other program areas--particularly weapons, nuclear ramjets and auxiliary power.

* Military and Space Reactors -- Biggest change here is the long-expected decision to concentrate on one type of aircraft nuclear reactor for propulsion. Indications are that the approach being undertaken by Pratt and Whitney will win out over the "fly early" system being designed by General Electric Co. Increases will be allocated principally for development of Project Rover nuclear rockets and Project Pluto ramjet engines, with funding near 1961 levels for transportable power reactors, small reactors to provide power and heat for satellites and other special purposes. In the naval reactor program, efforts will be made to develop longer lived nuclear fuel.

* Civilian Reactors -- Expenditures of \$250 million estimated for 1962 will support major development efforts on seven reactor types, and preliminary studies and experimental work on a number of other reactor concepts. Mr. Eisenhower told Congress that "the breadth and scope of our technology in this field are unmatched in the world." In the next 18 months the total number of major Government-owned experimental power reactors in operation will increase by 5 to a total of 10, and the number of power reactors operating in public and private utility systems will increase from 3 to 10. The 1962 budget proposes additional funds for cooperative arrangements with private and public power groups.

Long Range Research -- Physical research funds are estimated at \$171.3 million, up from the \$163.8 million in 1961. This does not include the Stanford accelerator project, mentioned under Special Fields of R&D Emphasis. Development of experimental devices to achieve a controlled thermonuclear reaction (Project Sherwood) will be continued at four AEC laboratories, although funds will be somewhat lower due to completion of facilities. Major new construction projects include a high energy physics building at Argonne National Laboratory, Lemont, Ill.; a chemistry laboratory at Brookhaven National Laboratory, Upton, L.I., N. Y. and a mechanical shops building at Lawrence Radiation Laboratory, Berkeley, Calif. Spending for research in chemistry and metallurgy will continue to increase in 1962. About 74 percent of the physical research program is conducted at 13 AEC laboratories, and the remainder -- some 510 projects -- is supported in more than 140 universities, colleges, institutes, and independent laboratories.

* Weapons -- Expenditures for production of nuclear weapons in 1962 will increase over 1961 but funds for development of weapons will be carried out at the same rate. Work will be carried forward to improve methods for seismic detection of underground nuclear weapons tests and improved methods for detecting high altitude nuclear weapons tests in Project Vela. The Nevada test site will be kept on a standby basis.

* Isotopes and Plowshare -- Funds are increased from \$3.8 million in 1961 to \$5.5 million in 1962 for isotopes development, looking toward a broad base of new and improved technology. Expenses level off somewhat for Project Plowshare for the peaceful uses of nuclear explosions, pending some action on the nuclear test moratorium.

* Training -- Two schools will be operated in 1962: The International Institute of Nuclear Science and Engineering at the Argonne National Laboratory and the Puerto Rico training center. About 150 college graduates will receive assistance for graduate training in reactor technology; 133 fellowships will be offered and grants will be made to help universities obtain reactor training equipment, teaching aids, demonstration apparatus and special laboratory equipment.

* NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

Expenditures for civilian space activities continue to soar in 1962, with every expectation that this will be increased by the Kennedy Administration.

Two major developments here:

(1) Mr. Eisenhower's assertion that "Further testing and experimentation will be necessary to establish whether there are any valid scientific reasons for extending manned space flight beyond the Mercury program" -- and the resultant decision not to sign systems contracts for the Project Apollo three-man space capsule.

(2) A remarkable expansion of communication satellite programs for civilian purposes -- from \$3.9 million in 1961 to \$68.6 million in late 1961 and 1962, with the anticipation that private firms will provide an additional \$10 million in 1962 in support of commercial applications. To be known as Project Relay.

Total expenditures for civil space programs are estimated at \$965 million for 1962, which is \$195 million more than in 1961 and \$564 million more than in 1960. Appropriations of \$1.1 million for 1962 and \$50 million in additional sums for 1961 are recommended in the budget.

NASA RESEARCH PLANS

✓ Aerodynamics and environmental physics -- A major problem here is the finding of aerodynamic shapes, unmanned and manned, which can be controlled during sudden injection in orbit or deep space trajectory, and which will survive a controlled return journey through the earth's atmosphere, at speeds decreasing from hypersonic to subsonic, to a specific landing area and eventually to a controlled landing point.

✓ Propulsion and energy conversion -- Increasing effort in 1962 on research related to space vehicle propulsion by nuclear and electric means and to methods of electrical power generation to make electric plasma and ion jet propulsion possible. In addition, substantial work on more sophisticated chemical propulsion systems and some advanced air-breathing engine work.

✓ Structures -- Research will increase in efforts to find strong but lightweight structures which can withstand the vibration, shock, heat, radiation and other environments encountered on various aeronautical and space missions.

✓ Materials -- Improved materials are needed for space vehicles, high performance aircraft and for instruments which make possible recording and transmission of test data back to earth.

✓ Life Sciences -- Increased emphasis on the problems of assuring man's contribution to the success of space flight missions; to the study of space environmental effects on living organisms to advanced basic biological sciences; and to the detection, collection and analysis of possible extraterrestrial life forms.

SPACE FLIGHT PROGRAMS

✓ Scientific Investigations -- Two major projects will absorb heavier spending -- the larger orbiting astronomical observatory and the orbiting geophysical observatories. Increases also in Ranger, Surveyor and Prospector programs for unmanned lunar exploration, and the Mariner program of probes to the vicinity of Mars and Venus, with initial launchings scheduled for 1962.

NASA (Continued)

✓ Satellite Applications -- Funds in a proposed supplemental appropriation will enable work to begin in Fiscal 1961 on Project Relay, the new active communication satellite program for civil uses. Mr. Eisenhower states that "We are now ready to take the first steps leading to a practical satellite communications system for commercial use. While the special nature of space operations makes it necessary and proper for the Government to take the lead in advancing the needed research and development of satellites for commercial communications use and to conduct the launchings, private industry should participate in the development phase and should be aggressively encouraged to assume the costs of the establishment and operation of the commercial system." Mr. Eisenhower did not express an opinion as to allocation of profits, if any.

Work will also continue on rigidized passive communications satellites of the Echo satellite type and meteorological satellites such as Tiros I and II. In 1962 emphasis will be on the Relay program, and on the advanced Rebound passive communications and Nimbus meteorological satellites.

✓ Manned Space Flight -- Project Mercury funds are expected to be somewhat lower in 1962 as the program goes into the flight stage. It had been planned to award contracts for the Apollo series of manned space capsules, but this was previous to the comments of Mr. Eisenhower. Now the budget allows primarily for "boiler-plate" Apollo capsules for what is called "studies and experiments which may lead to long-lived orbiting space stations and manned circumlunar flights."

SPACE VEHICLE AND SUPPORTING DEVELOPMENT

✓ Vehicle Systems -- Emphasis here will be on the small Scout solid propellant space vehicle; Centaur, larger and more power than existing launch vehicles because of the use of high-energy liquid hydrogen in the upper stage; and Saturn which will produce a thrust of 1.5 million pounds in the first stage with conventional propellants and will use liquid hydrogen in upper stages. The direct R&D costs of Saturn in 1962 are estimated at \$168.2 million -- an extremely large share of the NASA budget (and a program which Mr. Kennedy's scientific advisors have already singled out for careful scrutiny.)

✓ Propulsion Technology -- Efforts will continue on the single chamber 1.5 million pound thrust F-1 engine; advanced engines of other types, electrical propulsion systems and solar electric power supply systems for spacecraft. Development of nuclear rocket engines and nuclear electric power systems (Project Snap) will continue in cooperation with the AEC.

✓ Other Development -- Funds will support the technology necessary for guiding interplanetary space vehicles, attitude control of spacecraft, improved equipment for launch operations, advanced space vehicle designs and similar programs.

CONSTRUCTION AND EQUIPMENT

Programs will include a facility to determine the properties of structures in a hard vacuum and equipment for research in the properties and space uses of plasmas at Langley Research Center; hypervelocity free flight facilities and a life sciences research headquarters at Ames Research Center; a space environmental testing laboratory, an advanced data processing laboratory and an isolation laboratory at Goddard Space Flight Center; new and modernized laboratories at Jet Propulsion Laboratory; New facilities for tracking, dynamic balancing of launch vehicles and safety system at Wallops Station; completion of two Saturn launching facilities at the Atlantic missile range as well as a new Centaur launching facility; improvements to the Minitrack and deep-space tracking networks and equipment for a new radar for use in the Relay program and propulsion development facilities for the F-1 Engine and the 200,000 pound liquid hydrogen engine intended for an advanced Saturn.

* NATIONAL BUREAU OF STANDARDS

Proposed increase of \$4,247 thousand for the research programs of the NBS will provide expansion in a number of fields. Emphasis will be given to standards for radio and microwave quantities, measurement and standards programs in plasma physics and astrophysics, and to high-temperature standards and measurement methods. Chemistry and metallurgy divisions will continue their emphasis on fundamental properties of materials under varying environmental conditions, and on the preparation and analysis of high purity substances. Mechanics and engineering divisions will conduct studies of the engineering properties of materials under varying environmental conditions and on the preparation and analysis of high-purity substances. A comprehensive program of basic and applied research on flames and fires will be funded. Research contracts abroad will be financed with excess foreign currencies.

Equipment budget includes \$440 thousand for completion of a scatter radar transmitter and antenna designed to study the character of the upper atmosphere and \$284 thousand for construction and equipping of a standard frequency broadcast station. In addition anticipated costs in 1962 include \$151 thousand for an atomic frequency standard financed in prior years. Construction budget includes new facilities at Gaithersburg, Md., Boulder, Colo. and Hawaii as well as \$100 thousand for the design and engineering of a nuclear research reactor and additional sums for radiation physics research equipment and facilities for large force measurements.

* WEATHER BUREAU

The Weather Bureau, after a long intra-Governmental struggle, takes over responsibility for much of the meteorological satellite research program from NASA. Total R&D financing will reach \$9 million compared with \$6.4 million in 1961. Steps will also be taken to "supply the most modern computer techniques to a mathematical description of atmospheric motions."

Other R&D funds will go for research into hurricanes, tornadoes and other severe storms, atmospheric processes and forecasting methods, programs to improve terminal and enroute weather services for civil and military aviation and development and improvement of satellite and other instrumentation, and automation methods. Funds are included for purchase of weather surveillance radar with 250 mile range and for ground installations to continuously track radio transmitters carried to 100,000 feet by sounding balloons, as well as miniaturized equipment for use on shipboard to obtain measurements of high altitude weather conditions.

* FEDERAL AVIATION AGENCY

Research and Development efforts here climb to \$73 million, compared with \$46 million in 1961. Emphasis will be placed on completing the development and evaluation of a semiautomatic data processing and display system for air traffic control. Other projects include development of advanced altitude-sensing radar, improved long range navigation systems, blind landing aids and better approach lighting for airports. Work will be expanded in the fields of fire protection, structural soundness, collision avoidance as well as other aircraft systems and equipment that effect safety. Research for these programs is conducted through contracts with qualified firms, universities and individuals, or by Agency staff or other Governmental agencies. Research in aviation medicine in 1962 will be significantly increased, particularly at the Civil Aeromedical Research Institute recently established at Oklahoma City, Oklahoma.

* OFFICE OF SALINE WATER

This Agency administers federally sponsored research in saline water conversion, coordinates some 100 Federal and non-Federal projects, with funds almost double the 1961 figures. Preconstruction planning has been completed on three conversion plants, and will be completed on two others by the end of calendar year 1961. Construction is well underway on the first sea water conversion plant at Freeport, Tex. and recently has started on two others -- a sea water plant at San Diego, Calif. and a brackish water plant at Webster, S. Dak. The 1962 program provides for construction of the second brackish water plant at Roswell, New Mex. and a third sea water plant at an east coast location.

* OFFICE OF COAL RESEARCH

About \$1 million is to be spent on contract R&D by this new office in 1961 and 1962. Research is to be accomplished by recognized coal associations, educational institutions and agencies of states and political subdivisions. For further details of this office see Washington SCIENCE TRENDS, December 5, 1960.

* POST OFFICE DEPARTMENT

Postal authorities expect to spend almost \$12 million in 1962 for contract research, development and engineering. Industrial R&D program includes design, development and testing of new types of postal equipment and materials, development of better work methods and design, modification and mechanization studies. Specific programs are not detailed.

* GEOLOGICAL SURVEY

Increases here go for such programs as topographic mapping, field and laboratory research in economic geology, regional geology and geologic processes. It is pointed out that over the next decade such information will have increasing importance, not only in the exploration, development and appraisal of the Nation's mineral resources, but also in the fields of public health and safety and the exploration of space and oceans.

* BUREAU OF MINES

A variety of research programs here, at levels not much different than those of recent years. Research will be conducted on development of a stationary coal-burning gas turbine to provide a method of increasing the efficiency of steam-generating equipment. Laboratory studies will be continued to find feasible methods for converting coal to fluid fuels. Improved recovery and utilization for petroleum, natural gas and oil shale will be a major goal.

Studies will be made on the use of low-grade ores, conservation of raw materials and improved methods for steelmaking; the investigation of manganese occurrences and the use of low grade manganiferous materials; investigation of domestic chromite deposits; studies to lower production costs of offgrade ores; research on use of alloying metals; investigations and development of new sources of copper, lead and zinc, recovery of tin and mercury from low-grade ore, and new uses for arsenic, as well as a wide variety of other tasks.

* COAST AND GEODETIC SURVEY

Some slight addition to the Budget this year for surveys and charts, earthquake investigations and basic and applied research and development in oceanography, geodesy, geomagnetism, seismology, cartography, photogrammetry, gravimetry, astronautics and related supporting fields.

* ARMY PROGRAMS

Army spending plans are up somewhat for 1962, reflecting a continuing effort in modernization and increased inventories of combat and support equipment, particularly of newly developed items.

✓ Firepower -- This program will continue production of the M-60 medium tank to provide greater fire power, range and crew protection; the M-14 light-weight rifle, M-60 machine gun and an acceleration in the production of NATO standard ammunition; a third substantial increment of the Davy Crockett man-carried nuclear rocket will be purchased as well as a shoulder-fired medium assault weapon to provide increased antitank capability to combat infantry. Provision is made for introduction of a new air-transportable mortar, which together with the 175-mm. self-propelled gun procured in 1961 and the new 105-mm., 155-mm. and 8-inch air transportable howitzers will provide increased firepower and mobility. Modification of the M 48A1 series tanks will continue. Development effort on Shillelagh, a short-range combat vehicle mounted weapon system primarily useful against enemy personnel and tanks will be emphasized. Major emphasis continues on the Nike-Hercules improvement program. Production of the Hawk missile system will continue for defense against low altitude aircraft and air-breathing missiles. Procurement of the Redeye, missile system designed to arm small combat units against low altitude enemy aircraft will continue. About one quarter of a billion dollars will be provided for the development and testing program of the Nike-Zeus anti-missile-missile, culminating in full-scale system tests in the summer of 1962. Substantial sums will be devoted to continued development of the solid fuel tactical missile Pershing. Work will go forward on a new highly mobile surface-to-surface missile to support battle groups, presumably "Missile A", and on Mauler, a surface-to-air missile. Production will continue on the improved Honest John and Little John rockets and the Sergeant missile

✓ Mobility -- In this category, the Army will continue procurement of the M-113 aluminum armored personnel carriers, additional tactical trucks and the new M-88 tank recovery vehicle. A new armored full-track wrecker and a modern heavy equipment transporter will be procured for the first time to repair and recover vehicles in the 15-30 ton-weight class, and to carry combat vehicles in the 50-60 ton-weight class. Aerial programs provide for procurement of 261 aircraft, 50 percent more than in 1960 and include the twin engine Mohawk observation plane; the Caribou transport; the Iroquois utility transport and the Chinook designed to carry 26 fully armed troops or 3 tons of normal cargo. The Army will also initiate development of a new surveillance aircraft and will join with the other services in development of a prototype vertical takeoff and landing transport.

✓ Communications-Electronics -- Emphasis here is on swift, accurate target surveillance equipment and light, rugged mobile communication equipment which will support a high degree of mobility and dispersion. Plans are for procurement of surveillance and navigational equipment for Army aircraft, additional short endurance combat surveillance drone systems, first procurement of test USD-5 long endurance combat surveillance drone systems and modernization and replacement of combat radio, telephone and teletype communications and control equipment. Improvement of the Missile Master system to insure compatibility with Sage will continue.

✓ Logistics -- Procurement here includes materials handling and construction equipment, rolling fluid transporters and other items. First new nuclear mobile powerplant will be purchased and a variety of generators will be bought for remote power.

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